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2   APPLICATION FOR PATENT

3

4   of

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8   for

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10   RESILIENT MAGNETIC PAINTBRUSH HOLDER

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13   BACKGROUND OF THE INVENTION

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15   Painters have found that a brush holder of some type is a very useful item.

16   The brush holder avoids the need to lay a wet brush on a surface which may not be clean.

17   Further, the holder keeps the brush from falling into the paint in the paint can, particularly

18   if the brush is relatively small and the can is relatively full. Also, a brush holder serves to

19   maintain the brush in a ready-to-use condition and at a consistent location.

20   Because of the usefulness of a brush holder, inventors have devised a large

21   number of holders for supporting a paintbrush in a paint can. In one type of paintbrush

22   holder, the holder includes a clamp that grasps the handle of the paintbrush. In another type

23   of holder, a magnet is used to hold the paintbrush by magnetic attraction between the magnet

24   and the ferrule of the paintbrush. The present invention is an improvement on the magnetic

25   type of paintbrush holder.

26   In a typical magnetic paintbrush holder of the prior art, the magnet included

27   a pole face that is located in a vertical plane or an inclined plane. The ferrule of the brush

28   is drawn against the pole face by magnetic attraction, and this force is in a direction

perpendicular to the pole face. The friction between the ferrule and the pole face causes the existence of a force that opposes movement of the ferrule in any direction along the pole face. If the force of magnetic attraction is F, then the frictional force resisting motion parallel to the pole face is μF, where μ is the static coefficient of friction.

A second force at work is the weight W of the paintbrush. If the pole face is inclined with respect to the horizontal by an angle θ, the component of the weight of the paintbrush in a direction parallel to the pole face is W sin θ. In order for the paintbrush not to slide along the pole face, it is necessary for W sin θ to be less than μ times F. That is,

$$W \sin \theta < \mu F$$

where W is the weight of the paintbrush, θ is the inclination of the pole face with respect to the horizontal, F is the force of magnetic attraction between the pole face and the ferrule and, μ is the coefficient of static friction. If the pole face lies in a vertical plane, this equation reduces to

$$F > \frac{W}{\mu}$$

From this it can be seen that if the coefficient of static friction is 0.2, and if the paintbrush weighs 1.0 pounds, then the magnetic force must exceed 5 pounds to prevent the paintbrush from sliding downward along the pole face.

If the magnetic force is only slightly greater than the force required to prevent the paintbrush from sliding when the paint can is stationary, problems will arise if the paint can is suddenly picked up or set down by the user. When the can is picked up, the "g-force" that we feel in an ascending elevator causes the brush to behave as if it were substantially heavier. This tends to cause the brush to slide downward along the pole face and into the paint. On the other hand, if the paint can is set down abruptly, the inertia of the paintbrush will again cause it to slide downwardly along the pole face and into the paint.

To make matters worse, for the great majority of materials, the coefficient of sliding friction is less than the coefficient of static friction. This means that once the brush starts to slip, the frictional force opposing its motion actually decreases, thereby locking it into a sliding mode.

1   One's initial impulse might be to make the magnet stronger. However, upon

2   reflection this is seen to be a very limited solution. Typical magnetic forces are in the one-

3   five pound range. Increasing the magnetic force beyond this level would require the painter

4   to wrestle with the holder to free his paintbrush, and most painters will lose patience with this

5   after a number of repetitions. Further, serious safety problems may result if the painter is

6   working on a ladder or in some other awkward position.

7   In summary, existing magnetic paintbrush holders are susceptible to

8   mechanical shocks and accelerations, which cause the brush to become dislodged and to fall

9   into the paint.

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SUMMARY OF THE INVENTION

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14   As discussed above, a major shortcoming of existing magnetic paintbrush

15   holders is their inability to withstand sudden mechanical shocks, which cause the paintbrush

16   to become dislodged and to fall into the paint. Recognizing that making the magnet stronger

17   renders the device impractical because of the difficulty in releasing the brush from the holder,

18   the present inventor set out to solve the problem.

19   His main insight was in recognizing the need to mechanically isolate the

20   paintbrush and magnet from the paint can.

21   His solution is to insert a resilient member between the magnet and the paint

22   can. In one embodiment, the resilient member is a spring. In another embodiment, it is a

23   length of a resilient material. In these embodiments, any mechanical shocks felt by the paint

24   can are absorbed by the resilient member, and in this sense, it could be said that the invention

25   lies in inserting a shock absorber between the magnet and the paint can. In general, the

26   shock absorbing member may be part of a one-piece article that includes the clamp that is

27   used for attaching the device to the paint can.

28   The novel features which are believed to be characteristic of the invention,

29   both as to organization and method of operation, together with further objects and

30   advantages thereof, will be better understood from the following description considered in

1 connection with the accompanying drawings in which several preferred embodiments of the

2 invention are illustrated by way of example. It is to be expressly understood, however, that

3 the drawings are for the purpose of illustration and description only and are not intended as

4 a definition of the limits of the invention.

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7 BRIEF DESCRIPTION OF THE DRAWINGS

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9 Fig. 1 is an exploded perspective view showing a first preferred embodiment

10 of the resilient magnetic paintbrush holder of the present invention;

11 Fig. 2 is an exploded perspective view showing a second preferred

12 embodiment of the present invention;

13 Fig. 3 is a diagram used for explaining the invention; and,

14 Fig. 4 is a diagram used for explaining the invention.

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17 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

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19 Fig. 1 shows a first preferred embodiment of the present invention. In that

20 embodiment, a spring 2 connects the clamp 6 with a magnet 1. In this embodiment, caps 3

21 are secured to both ends of the spring 2. One of the caps is bonded to the magnet 1 by the

22 use of an epoxy adhesive, and the other cap is bonded to the channel 4 portion of the

23 clamp 6. The clamp includes a thumb screw 5 that is used for securing the clamp to the rim

24 of an open paint can.

25 Fig. 2 is an exploded perspective view showing a second preferred

26 embodiment of the invention. In this embodiment, the clamp 6 (except for the thumb

27 screw 5) the resilient member 7, and the magnet holder 8 are fabricated by a molding process

28 and constitute a one-piece structure. The magnet 1 is bonded into the magnet holder 8, and

29 the thumb screw 5 is added. The clamp 6 fits over the rim of the paint can and is secured in

30 place by tightening the thumb screw 5.

In both embodiments, the thumb screw clamp 6 may be replaced by a resilient clamp without departing from the spirit of the invention.

Figs. 3 and 4 are diagrams used for explaining the invention. In Fig. 3, the pole face of the magnet 1 is shown as being inclined at an angle θ with respect to the horizontal. The magnetic attraction force is denoted by F, and is perpendicular to the pole face. The weight W of the paintbrush is vertically downward and its component parallel to the pole face is W sin θ. The frictional force always opposes motion and its magnitude is μ F where μ is the static coefficient of friction.

In order for the paintbrush not to slide down the pole face, it is necessary for the frictional force μ F to be greater than the downward component of the weight, namely W sin θ. If the pole face is vertical, sin θ equals 1.0 and the weight of the paintbrush must be less than μ F.

The coefficient of static friction depends on the specific materials involved; for metals it might be on the order of 0.2. This would imply that a magnetic attraction force of 5 pounds would result in a frictional force of only 1 pound.

Turning now to Fig. 4, the paintbrush 9 and magnet 1 located at the end of the resilient portion 7 will vibrate up and down as indicated by the arrows, when set into motion. One way to set the brush into vibratory motion is for the user to set the paint can down abruptly onto a hard surface.

Thus, it is recognized that the system comprised of the paintbrush and resilient portion constitutes a classical physics situation of a mass mounted on a spring; such systems have been thoroughly studied. The time required for one complete cycle of the vibration is

$$T = 2\pi \sqrt{\frac{M}{K}}$$

where

T is the time in seconds for one complete cycle of vibration,

π is 3.1416

M is the mass in pound second squared per foot, found by dividing the weight W of the magnet and paintbrush in pounds by the gravitational

1   acceleration of 32 feet per second squared,

2   and   K is the force constant of the resilient member in pounds per foot,

3   determined experimentally by observing the deflection that results when

4   the resilient member is loaded with a known weight.

5 For example, if the paintbrush weighs 0.5 pound and it requires 3 pounds to produce a

6 deflection of one inch, then the time required for one complete cycle of the vibration is

7 0.1307 seconds; the frequency of the vibration is 7.65 cycles per second.

8   The maximum displacement of the brush occurs at the end of the first quarter

9 cycle after the paint can is set down. In the example, that is 0.0327 seconds after the can is

10 set down. At that time, the instantaneous velocity is zero; but because the elastic restoring

11 force is greatest, the acceleration is also greatest. The acceleration at maximum displacement

12 can be calculated by the equation

$$a = \frac{K}{M} D$$

15 where a is the maximum acceleration and D is the maximum displacement. That is, the

16 acceleration depends on how hard the paint can was set down. To find the maximum

17 deflection, consider that the paintbrush continues _its_ downward motion against the restoring

18 force of the resilient member until all of the initial kinetic energy of the brush and magnet

19 $\frac{1}{2}M V_0^2$ has been converted into potential energy stored in the resilient member, where V_0

20 is the velocity of the paintbrush as the paint bucket is being set down. This potential energy

21 (P.E.) may be calculated by the equation

$$P.E. = \frac{1}{2} K D^2$$

24 Equating the initial kinetic energy to the potential energy at the maximum displacement gives

25 the equation

$$\frac{1}{2} M V_0^2 = \frac{1}{2} K D^2$$

28 from which D can be calculated as

$$D = V_0 \sqrt{\frac{M}{K}}$$

1   If V_0 is 0.5 ft. per second, the maximum displacement is 0.1248 inch, and the acceleration

2   is found to be 24 ft/sec², which equals 0.75"g".

3   If the paintbrush weighs 0.5 pound and is subjected to an additional 0.75"g",

4   the maximum downward force of the paintbrush is 0.875 pound.

5   If the force of magnetic attraction is 5.0 pound and the coefficient of static

6   friction is 0.2, the frictional force is 1.0 pound and the brush should not slide off the magnet.

7   The advantage of the present invention can best be seen by combining the

8   equation given above for the maximum acceleration a with the equation for the maximum

9   displacement D, giving

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$$a = \frac{K}{M} D = \frac{K}{M} V_0 \sqrt{\frac{M}{K}} = V_0 \sqrt{\frac{K}{M}}$$

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12   From this equation it is seen that, assuming the mass M and the velocity of

13   the brush to be constant, the maximum acceleration of the brush is proportional to the square

14   root of K. The stiffer the resilient member is, the greater the maximum acceleration. In the

15   above example it was assumed that the spring had a force constant K equal to 3 pound per

16   inch (equals 36 lb./ft.).

17   By way of contrast, if the spring were replaced by a rigid bracket such as

18   those used in the prior art, the force constant K could be 3 lb. per hundredth of an inch

19   (equals 3600 lb./ft.). It is seen that, in this example, the use of the spring instead of a rigid

20   bracket reduces the maximum acceleration of the brush by a factor of 10, from 7.5"g" to

21   0.75"g", and the maximum downward force of the paintbrush is reduced from 4.25 pounds

22   to 0.875 pound. This reduction clearly makes the difference between the paintbrush

23   remaining on the magnet and its being jarred off the magnet and falling into the paint.

24   Thus, there has been described a magnetic paintbrush holder that incorporates

25   a resilient member to reduce the mechanical shocks felt by the brush.

26   The foregoing detailed description is illustrative of several embodiments of

27   the invention, and it is to be understood that additional embodiments thereof will be obvious

28   to those skilled in the art. The embodiments described herein together with those additional

29   embodiments are considered to be within the scope of the invention.

30   What is claimed is: